

Trauma Clinical Guideline: Identifying Cervical Spine Injuries

The Trauma Service Directors' Workgroup is an open forum for the directors of designated trauma services in Washington State to share ideas and concerns regarding the provision of trauma care. The workgroup meets twice a year to encourage communication between services so that they may share information and improve the quality of care that they provide to patients. On occasion, at the request of the Governor's Steering Committee on EMS and Trauma Care, the group discusses the value of specific guidelines for trauma care procedures.

This guideline is distributed by the Washington State Department of Health on behalf of the Governor-Appointed Steering Committee on Emergency Medical Services and Trauma Care to assist other trauma care services with the development of their trauma patient care guidelines. Toward this goal the Trauma Service Directors have categorized the type of guideline, the sponsoring organization, how it was developed, and whether it has been tested or validated. It is hoped that this information will assist the physician in evaluating the content of this guideline and its potential benefits for their practice or any particular patient.

The Department of Health does not mandate the use of this guideline. The Department recognizes the varying resources of different services and that approaches that work for one trauma service, may not be suitable for others. The decision to use this guideline in any particular situation always depends on the independent medical judgment of the physician. It is recommended that trauma services and physicians that choose to use this guideline consult with the Department or Eastern Association for the Surgery of Trauma, the original developer of the guideline, on a regular basis for any updates to its content. The Department appreciates receiving any information regarding practitioners' experiences with this guideline. Please direct comments to Mary Rotert RN, 360 705-6729 or mary.rotert@doh.wa.gov

This is a trauma assessment and management guideline. It was adapted from the Eastern Association for the Surgery of Trauma website. The trauma medical directors group reviewed the guideline, sought input from trauma care physicians throughout Washington State, and used that input to make the indicated changes. The guideline was then endorsed by the Steering Committee, and by the DOH Office of EM/TP. This guideline has not been tested or validated. Further information and the original guideline is available at www.east.org

Practice Parameters for Identifying Cervical Spine Injuries Following Trauma

EAST Practice Parameter Workgroup for Cervical Spine Clearance

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I. Statement of the Problem

Determination of the stability of the cervical spine is a common problem encountered by those charged with the responsibility for the acute care of trauma patients. Several specific issues are of particular concern for medical, economic and legal reasons: who needs cervical spine radiographs; what views of the cervical spine should be obtained; when should flexion/extension radiographs, fluoroscopic radiographs, CT scans, or MRI scans be obtained; and how do we demonstrate the absence of significant ligamentous injury in the comatose trauma patient.

II. Process

A. Identification of references

A computerized search of the National Library of Medicine was undertaken using "Grateful Med" software. All English language citations during the last 20 years with "cervical spine" in the title, and the subject words "radiography", "cervical vertebrae," and/or "trauma" were retrieved. Of the 961 citations retrieved, 160 dealt with the determination of cervical spine stability in the first few hours after trauma, and these articles were selected for further review. Ninety-eight were either general reviews, letters to the editor, or were considered of such poor quality as to not warrant inclusion in this document. This left 62 articles which were primarily original studies of large groups of patients, or smaller, well- conducted studies addressing specific questions relevant to this practice parameter.

B. Quality of the references

The quality assessment instrument applied to the references was uniquely developed for this project. There have been no such instruments previously developed for use with articles that do not deal with therapies, and clearance of the cervical spine is a question of diagnosis rather than therapy. Five factors were considered essential to high quality articles regarding the diagnosis of cervical spine injury: 1) study population greater than 100 patients, 2) a well-defined population at risk, 3) prospective study, 4) a description of the specialty or specialties of the physicians charged with interpreting the radiographic studies, and 5) a specific description of the studies obtained.

III. Recommendations

A. Level I

There is insufficient evidence to support a Level I recommendation for this practice parameter.

B. Level II

1. Trauma patients who are alert, awake, have no mental status changes, no **significant*** neck pain, no distracting pain, and no neurologic deficits may be considered to have a stable cervical spine and need no radiologic studies of their cervical spine.

2. All other trauma patients should have the following three cervical spine x-rays: lateral view revealing the base of the occiput to the upper border of the first thoracic vertebrae, anteroposterior view revealing the spinous processes of the second cervical through the first thoracic vertebra, and an open mouth odontoid view revealing the lateral masses of the first cervical vertebra and entire odontoid process. Axial CT scans with sagittal reconstruction should be obtained for any questionable level of injury, or through the lower cervical spine if this area cannot be visualized on plain radiographs. All life-threatening hemodynamic and pulmonary problems should be addressed before a prolonged c-spine evaluation is undertaken. Before removing cervical spine immobilization devices, all radiographs should be read by an experienced emergency medicine physician, neurosurgeon, orthopedic spine surgeon, radiologist, or other physician with expertise in interpreting these studies.

3. If the cervical spine radiographs are normal but the patient complains of significant neck pain, cervical spine radiographs with the patient actively positioning their neck in extreme flexion and extension positions should be obtained.

4. If the patient has a neurologic deficit that may be referable to a cervical spine injury, they should have a ~~immediate~~ **timely*** surgical ~~subspecialty~~* consultation and MRI scan of the cervical spine.

5. Trauma patients who have an altered level of consciousness due to a traumatic brain injury, or due to other causes which are considered likely to leave the patient unable to complain of neck pain or neurologic deficits for 24 or more hours after their injury, may be considered to have a stable cervical spine if adequate three-view plain x-rays (CT supplementation as necessary) and thin cut (*3 mm cuts at 3 mm intervals*)* axial CT images through C-1 and C-2, are read as normal by an experienced physician.

6. If the patient has abnormalities of the cervical spine discovered on any of the radiographic or MRI images as recommended above, the surgical ~~subspecialty~~* responsible for spine trauma should be consulted.

Scientific Foundation

A. General

There have been no prospective, randomized studies regarding the use (or non use) of any single or group of imaging studies for the acute determination of cervical spine stability. Therefore, there can be no "standard" for this parameter.

**Washington trauma physicians recommended these changes.*

There have been numerous prospective and retrospective cohort studies of large numbers of trauma patients which provide some insight into the incidence of cervical spine injuries following blunt trauma (2-6%),^{2,7,13-15,18,26,29,31,34,39,43,50,52} the indications for cervical spine radiographs,^{2,5,7,20,21,26,28,29,31,40,42,43,48-50,54,62} and the types of radiographs most likely to detect cervical spine injuries.^{1,4,6,12,17,19,27,30,33,35,36,38,55-58,60} However, virtually all of the publications fail to clearly define the criteria used to decide who gets cervical spine radiographs and who does not. No study has carefully conducted long term follow up on all of their trauma patients to identify all cases of cervical spine injury missed in the acute setting. Thus, the true incidence of cervical spine injury is not known.

It is clear from the literature that no imaging modality is accurate 100% of the time.^{12,13,22,30,37,46,58,59,62} However, most studies have found that a 3-view spine series (AP, Lateral, and Open mouth odontoid view), supplemented by thin cut axial CT images with sagittal reconstruction through suspicious areas or inadequately visualized areas, provides a false negative rate of less than 0.1% if the studies are technically adequate and properly interpreted.^{2,6,13,19,41,52} CT alone,^{52,55} MRI,^{8,57} and flexion/extension radiographs^{12,33} have all been shown to miss injuries, and have not been shown to be more accurate than the above protocol.

B. Who needs cervical spine radiographs?

Numerous large prospective studies have found that no patient had a clinically significant cervical spine injury if they had no neck pain, no distracting pain, no neurologic deficits, and if they were alert, awake, oriented, and not intoxicated.^{2,16,26,29,31,43,50,53,54} There have been reports of cases in which there were bony or ligamentous abnormalities discovered in alert, awake patients who were truly asymptomatic,^{13,37} but we could find no reports of asymptomatic patients who suffered neurologic injury as a result of such bony or ligamentous abnormalities. Thus, asymptomatic patients as defined above probably do not need radiographic studies of their spine. Mechanism of injury has not been shown to be predictor of clinically significant cervical spine injuries independent of the above risk factors and should therefore not be used as an indication for spine radiographs in the absence of any other clinical indicators.^{2,13,15,25,28,47,51}

All patients with an altered level of consciousness, neck pain, distracting pain, neurologic deficits, or drug/alcohol intoxication should have a 3-view spine series with thin cut (*3 mm cuts at 3 mm intervals*)* axial CT scans with sagittal reconstruction through suspicious or poorly visualized areas. All studies must be technically adequate and read by an experienced physician. Technically adequate cervical spine x-rays are defined as: lateral view that includes the base of the occiput and the upper border of the first thoracic vertebrae; antero-posterior view that includes the spinous processes of C-2 through T-1; and open mouth odontoid view that clearly defines the lateral masses of C-1 and the entire extent of the odontoid process.^{2,9-11,13,46,50,52} In a carefully conducted prospective study, the addition of plain oblique cervical spine x-rays were not found to add to the diagnostic accuracy of the standard 3-view studies in identifying clinically significant injuries.¹⁹

If these screening radiographs are normal but the patient has a neurologic deficit that might be caused by a cervical spinal cord or root injury, they should have an MRI scan of the cervical spine obtained with the immobilization device left in place. MRI is a very sensitive study for soft tissue injuries including ligamentous injuries and post-traumatic lesions causing compression of the spinal cord or nerve roots such as disc herniation or hemorrhage.^{4,8,17,23,32,57} These injuries are not visualized with plain x-rays and poorly visualized with CT.

* *Washington trauma physicians recommended these changes.*

If the screening radiologic studies are normal but the patient complains of significant neck pain, plain lateral x-rays should be obtained with the patient actively flexing and extending their neck. Pure ligamentous disruption can result in significant cervical spine instability that will usually be detected with such stress studies.

If abnormalities are identified on any of these studies, the surgical specialty responsible for spine trauma should be consulted and the cervical spine kept immobilized. If all of these studies are normal when interpreted by a physician experienced in reading these radiographs, the cervical spine may be considered stable and immobilization devices removed.

C. Detection of cervical spine instability in the comatose trauma patient

An informal (unpublished) survey of several trauma programs in the U.S. revealed a wide variation in the methods used to manage the cervical spine in comatose trauma patients after screening radiographs are found to be normal. There is little or no literature support for most of these protocols, but a review of their theoretical advantages and disadvantages is useful for formulating the most reasonable and practical strategy for determining cervical spine stability in this group of patients.

D. Leave the cervical spine immobilization device in place indefinitely

Advantage: Limitation of extreme movements of the neck most likely to cause cord injury.

Disadvantages: No commonly used device (Philadelphia Collar, Miami-J Collar) limits neck mobility enough to prevent injury⁴⁴. Most hospitals severely restrict mobilizing patients who have a potentially unstable cervical spine, but early mobilization of comatose patients can help limit pulmonary complications, decubitus ulcers, and deep venous thrombosis.²⁴ Long term use of cervical collars can cause occipital decubitus ulcers.

E. Obtain flexion/extension fluoroscopy routinely

Advantage: Should reveal most significant ligamentous injuries.

Disadvantages: May not be necessary. A prospective study of 116 consecutive patients did not find any clearly unstable injuries;¹² false negative studies have been reported.^{12,33}

Who flexes and extends the neck? Most radiologists refuse. Staff surgeons are unlikely to have the time. Cord injuries have been reported as a result of this maneuver.³³ Are the junior house staff capable of doing the study safely?

F. Obtain MRI scans routinely

Advantage: May reveal ligamentous injury without having to stress the spine.^{4,8,57}

Disadvantages: False negative studies have been reported⁵⁷. Very sensitive to any soft tissue injury; no clear relationship between these injuries and clinically significant instability (high sensitivity, low specificity). Very expensive. Not possible for a substantial proportion of critically ill patients who require ferromagnetic hemodynamic monitoring devices, or are too ill to be in the scanner for the period of time necessary for the scan.

The few available studies that have focused on the incidence of cervical spine injury in comatose trauma patients suggest that traumatic brain injury is a risk factor for spine injury, and may increase the incidence to nearly 7%.^{3,25,30,61} However, it appears that most of those injuries can be detected with 3-view plain x-rays with CT as indicated (screening radiographs as described above). The one study that looked prospectively at the use of flexion/extension radiographs did not find them to be as sensitive in detecting cervical spine injuries.¹² However, one study did find that axial CT through C-1 and C-2 was useful in detecting injuries at these levels that were not seen on plain cervical spine x-rays.³⁰

Based on the available evidence, as well as the problems encountered with the approaches described above, screening cervical spine radiographs (3-views with axial CT through suspicious or poorly visualized areas) should provide the safest, most efficient, and most cost effective method for detecting clinically significant cervical spine injuries in comatose head injured patients. During the initial or follow up head CT scan, the upper two cervical vertebrae should be studied with thin cut axial CT scans. If all of these studies are technically adequate and properly interpreted, the cervical spine should be considered stable and immobilization devices removed.

IV. Summary

There have been no prospective, randomized studies of the use (or non-use) of any single group of imaging studies for the acute determination of cervical spine stability. Therefore, there can be no "standard" for this parameter.

There have been numerous prospective and retrospective cohort studies of large numbers of trauma patients which provide some insight into the incidence of cervical spine injuries following blunt trauma (2% to 6%), the indications for cervical spine radiographs, and the types of radiographs most likely to detect cervical spine injuries. However, virtually all of the publications fail to clearly define the criteria used to decide who gets cervical spine radiographs and who does not. No study has carefully conducted long-term follow-up on all of their trauma patients to identify all cases of cervical spine injury missed in the acute setting. Thus, the true incidence of cervical spine injury is not known.

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VI. Future Investigations

Future studies should prospectively evaluate and identify those imaging studies which should be utilized to make an acute determination of cervical spine injury and stability.

Complete references for the original EAST guideline are available at www.east.org or from:

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